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Eighteenth Quarterly Progress Report

on the

Mechanisms of Fire Ignition and Extinguishment

by

E. C. Creitz

Covering the period November 1, 1963 to February 29, 1964

for

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Covering the period November 1, 1963 to January 31, 1964

1. Summary

This report covers part of a continuing study of the mechanisms of chemical extinguishment of flames. Several improvements were made in the mass spectrometer to be used in the study of ionic processes in flames. Mr. Mills also measured the calibration factor and the loss of ions in the drift tube; only one in three survive to be counted at the exit. Theoretical considerations indicated that one may neglect the velocity modulation caused by the differentiation voltage used in the detector. The identities of ions formed by attachment of low energy electrons to SF_6, and the flame inhibitors CCl_4, CH_3Br and $Fe(CO)_5$ were determined. No ions could be found from the attachment of electrons by $Pb(C_2H_5)_4$.

2. The Mass Spectrometer

In an attempt to increase negative ion currents, several improvements were made. Additional deflection plates were installed for the purpose of centering the ion beam. A device for controlling the filament current by means of measurement of the electron emission was built and tried. It has been temporarily laid aside because of the short life of transistors which carried the filament current. Some minor improvements were made in the unipotential cathode in order to provide finer control of electron energies and two additional variable leaks were constructed so that the spectrometer could be used for the simultaneous comparison of the negative ions from two independent samples. The calibration factor was measured, as was the ratio of the number of ions entering the drift tube to the number leaving it. About two thirds of the ions are lost in the drift tube.

Theoretical work indicated that the velocity modulation caused by the differentiating voltage would not cause trouble. It was also determined that non-resonant ions would bunch just as well as resonant ions, but at different locations in the drift tube. This idea suggests that it might be possible to sweep through the ion masses by changing the length of the drift tube.

3. Results

Five compounds have been studied to date. Sulfur hexafluoride was found, as expected, to yield SF_6^- and SF_5^- ions. Carbon tetrachloride gave Cl^- ions , and CH_3Br gave Br^- ions. Iron pentacarbonyl, $Fe(CO)_5$, which is a powerful inhibitor, gave $Fe(CO)_4^-$ ions. This substantiates the reported tendency for $Fe(CO)_5$ to dissociate and recombine with undissociated molecules to form $Fe(CO)_9$. Lead tetraethyl, which Lee showed to be a moderately good electron attacher, gave no ions at all, at low electron energies. Two attempts were made to find negative ions. The difficulty has still not been solved.

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